Citation:

Macdiarmid J, Loe J, Craig LC, Masson LF, Holmes B, McNeill G. Meal and snacking patterns of school-aged children in Scotland. *Eur J Clin Nutr* 2009; 63: 1,297-1,304.

PubMed ID: 19707230

Study Design:

Cross-sectional study

Class:

D - Click here for explanation of classification scheme.

Research Design and Implementation Rating:

POSITIVE: See Research Design and Implementation Criteria Checklist below.

Research Purpose:

To describe the meal and snacking patterns of school-aged children and assess the nutrient intakes during term time and school holidays.

Inclusion Criteria:

- Ages 5 five to 17 years
- Listing in the Scotland Department of Work and Pensions Child Benefit Register
- Residence in one of 80 postcode sectors across Scotland
- Participation in the Survey of Sugar Intake among Children in Scotland
- Since the report was based on a sub-sample from a larger survey described elsewhere, IRB and consent procedures were not described.

Exclusion Criteria:

- Ages younger than five or older than 17 years
- Non-participation in the Survey of Sugar Intake among Children in Scotland
- Invalid estimated food record.

Description of Study Protocol:

Recruitment

A stratified sub-sample of 311 children ages three to 17 years were recruited from among participants in the Survey of Sugar Intake among Children in Scotland. The strata were not described.

Design

The cross-sectional study consisted of completing a four-day estimated food record, including three weekdays and one weekend day.

Dietary Intake/Dietary Assessment Methodology

- Participants kept four-day estimated food records
  - Estimates were made based on household measures and color photos
  - Photos varied with child age
- Parents or guardians kept the records for five- to 11-year-olds, with child assistance
- Those ages 12 to 17 years kept their own records with parental assistance
- Nutrient composition was calculated from the National Diet and Nutrition Survey nutrient databank.

Statistical Analysis

- The mean number of meals and snacks per day was compared across age, sex, body mass index (BMI) and socioeconomic groups, as well as weekday term time vs. school holidays, using the Mann-Whitney test
- During term-time only, within-subject comparisons between weekdays and weekend days were conducted with Wilcoxon's signed-rank test
- Differences in energy intake and percentage of energy from total fat, saturated fatty acids and non-milk extrinsic sugar were compared using T-tests
- Differences between term-time and school holidays were assessed using general linear models adjusted for age, sex and socioeconomic deprivation status
- Paired T-tests were used to examine weekdays vs. weekend days
- Associations between age, sex, BMI and socioeconomic deprivation status and eating breakfast on all four days were explored using Pearson's chi-square.

Data Collection Summary:

Timing of Measurements

Food diaries were kept over four consecutive days, including three weekdays and one weekend day.

Dependent Variables

- Mean number of meals and snacks per day:
  - Eating occasions were defined based on core vs. non-core food groups. A meal contained one or more core items. Snacks contained only non-core items. Eating occasions had to be separated by 30 minutes or more without any other foods or beverages being consumed
  - Core food groups were: Pasta, rice, pizza and other cereals; breads (whole meal or not); whole grain and high fiber or other breakfast cereals; eggs and egg dishes; meats and meat dishes; processed meat; fish and fish dishes (oily or not); vegetables; baked beans; potato products (fried or not)
  - Non-core food groups were: Biscuits, cakes and pastries; puddings; milk and cream; cheese; yogurt; ice cream; confectionery; crisps and savory snacks; nuts and seeds; sugar and preserves; fruit; fruit juice and smoothies; soft drinks (diet or lower sugar or not); alcoholic drinks; tea, coffee, and water; margarine/butter and oils; soups and sauces
- Mean daily intake of energy, total fat, saturated fatty acids and non-milk extrinsic sugar
- Percentage of food energy from total fat, saturated fatty acids and non-milk extrinsic sugar.

Independent Variables

- Age (five to 11, 12 to 17 years)
- Sex
- BMI (overweight or obese vs. neither)
  - Trained fieldworkers measured height and weight
  - Overweight and obesity were defined as 85th or higher percentile and 95th or higher percentile, respectively, of the 1990 United Kingdom reference data, and were combined into a single analysis category
- Socioeconomic deprivation status (lower deprivation, higher deprivation)
  - Based on the Scottish Index of Multiple Deprivation, in which postcode areas were grouped in quintiles, lower deprivation consisted of quintiles one and two with the remaining three quintiles comprising higher deprivation
- Term-time vs. school holidays
- Weekdays vs. weekend days
- Breakfast consumption (all four days vs. not). Breakfast was the first eating event of the day that included a solid food item and occurred by 9:00 A.M. on school days or 11:00 A.M. on weekends or holidays.

Control Variables

- Age
- Sex
- Socioeconomic deprivation.

Description of Actual Data Sample:

- *Initial N:* 311
- *Attrition (final N):* 156 (81 male, 75 female); 195 diaries were returned. Those from children ages three to four were excluded, for a final N of 156
  - Of those, eight were excluded from sub-group analyses, because they spanned holidays and term-time
  - Of the remaining 148, an additional eight were excluded from sub-group analyses, because they contained no weekend days
  - It is unclear how many of the 311 recruited fell into the ineligible age range (i.e., three to four years), so the actual response rate is unknown
  - Response rates did not differ by age group, sex or BMI group; lower socioeconomic groups were less likely to respond ($P<0.005$)
- *Age:*
  - 56% were age five to 11 years
  - 44% were age 12 to 17 years
- *Other relevant demographics:*
  - 44% lower socioeconomic deprivation
  - 56% higher socioeconomic deprivation
- *Anthropometrics:* 26% overweight or obese
- *Location:* Scotland.

Summary of Results:

- Participants ate a median of 3.3 meals and 2.0 snacks per day. Boys had more meals than girls (3.3 vs. 3.0; $P=0.03$). Those of higher socioeconomic deprivation had more meals (3.3 vs. 3.0; $P=0.04$) but fewer snacks (2.0 vs. 2.3; $P=0.005$) than those of lower deprivation. No age or BMI differences were observed
- The percentage of energy from saturated fatty acids and non-milk extrinsic sugar was significantly higher from snacks than meals; there was no difference for total fat. Snacks contributed about one-fifth of daily energy and total fat intake, one-fourth of saturated fatty acids and nearly 40% of non-milk extrinsic sugar. The contribution of snacks to nutrient intakes is shown in the following table; females had significantly more fat from snacks than males.

	Mean Percent of Total Daily Intake from Snacks

	Energy		Total Fat		Saturated Fatty Acids		Non-milk Extrinsic Sugar	
Group	**Mean (95% CI)**	**P-value**	**Mean (95% CI)**	**P-value**	**Mean (95% CI)**	**P-value**	**Mean (95% CI)**	**P-value**
All (N=156)	21.4 (19.7-23.1)		21.7 (19.7-23.6)		24.4 (22.2-26.6)		38.9 (35.8-42.1)	
Sex		0.19		0.04		0.09		0.95
Male	20.3 (17.8-22.7)		19.8 (17.0-22.5)		22.6 (19.5-25.7)		38.8 (34.3-43.3)	
Female	22.6 (20.1-25.1)		23.7 (21.0-26.3)		26.3 (23.3-29.4)		39.0 (34.5-43.5)	
Age		0.15		0.19		0.21		0.12
Five to 11 years	22.5 (20.3-24.8)		22.8 (20.3-25.3)		25.6 (22.7-28.5)		41.1 (37.0-45.2)	
12 to 17 years	19.9 (17.2-22.7)		20.2 (17.2-23.2)		22.8 (19.5-26.1)		36.1 (31.2-41.0)	
BMI		0.81		0.72		0.97		0.14
Not overweight or obese	21.7 (19.6-23.7)		21.8 (19.4-24.1)		24.7 (22.2-27.2)		37.6 (34.0-41.2)	
Overweight or obese	22.2 (18.5-25.8)		22.7 (18.3-27.0)		24.6 (19.8-29.4)		43.1 (36.2-50.0)	
Socioeconomic deprivation		0.06		0.41		0.65		0.86
Lower deprivation	23.2 (20.8-25.6)		22.6 (20.1-25.0)		24.9 (22.1-27.8)		39.2 (35.0-43.3)	
Higher deprivation	20.0 (17.5-22.4)		20.9 (18.1-23.8)		24.0 (20.8-27.2)		38.7 (34.0-43.3)	

- More frequent snackers (more than two a day) had significantly more eating occasions per day, fewer meals and higher daily intake of non-milk extrinsic sugar than less frequent snackers (two or less a day). See the following table
- The proportion of those eating breakfast on all four days was 83%; 10% skipped it only one day, 4% skipped two days, 1% skipped three days and 2% did not eat breakfast at all. Eating breakfast on all four recording days did not differ by snacking status.

	≤2 Snacks a Day (N=86)	>2 Snacks a Day (N=70)	
	Mean (95% CI)	**Mean (95% CI)**	**P-value**
Daily intake *(adjusted for age, sex, and socioeconomic deprivation)*			
Total energy (kJ)	6,793 (6,378 to 7,210)	7,126 (6,720 to 7,533)	0.08
Total fat (% kJ)	33.6 (32.5 to 33.6)	33.9 (32.9 to 34.9)	0.47
Sat. fatty acids (% kJ)	14.2 (13.6 to 14.9)	14.3 (13.8 to 14.8)	0.73
Non-milk sugar (% kJ)	13.9 (12.5 to 15.3)	17.0 (15.5 to 18.4)	0.005
	Median (IQR)	**Median (IQR)**	**P-value**
Total eating occasions	4.8 (4.3 to 5.3)	6.0 (5.5 to 6.8)	<0.001
Meals	3.3 (3.0 to 3.5)	3.0 (2.8 to 3.3)	0.005
	Percentage	**Percentage**	**P-value**
Breakfast on all four days	83	84	0.77

Other Findings

- Biscuits, cakes and pastries; crisps and savory snacks; and confectionery were more eaten as a snack, than as part of a meal. Fruit and ice cream were equally likely to be a snack or part of a meal. Soft drinks, fruit juice and milk were more likely to be part of a meal than a snack
- Breakfast cereal, milk and bread were the most common breakfast foods. Nearly one-third of the children had fruit juice, 20% had non-diet soft drinks and 14% had soft drinks. Milk and cream, biscuits and cakes and pastries were more likely to be consumed by younger children; there were no sex differences for food groups
- There were no differences in the number of eating occasions or nutrient intake between term time and school holidays
- The number of eating occasions on weekdays was higher than on weekends (5.3 vs. 5.0; P=0.002), due to more variation in the number of meals on weekdays; the median of three meals a day did not differ between weekdays and weekends
- There were no differences in nutrient intakes between weekdays and weekends
- Older children were less likely to eat breakfast daily than younger children (74% vs. 91%; P=0.004). There were no sex, BMI or socioeconomic deprivation status differences, nor differences in breakfast eating on weekdays during term time vs. holidays.

Author Conclusion:

- Although the children ate three meals a day and breakfast regularly, their nutrient intakes exceeded the more than or equal to 11% food energy recommendation for non-milk extrinsic sugar (17%) and saturated fatty acids (14%). Snacks were approximately one-fifth of energy intake
- More frequent snackers had higher intakes of non-milk extrinsic sugars that less frequent snackers, but total energy intake, percent of food energy from fat and percent of energy from saturated fatty acids did not differ by snack status
- Total fat from snacks contributed a larger portion of food energy for girls than boys
- Methodological differences in defining meals and snacks makes comparisons difficult, but eating frequency appears to be stable over time in Scottish children
- Many snack foods were consumed with main meals. Thus, dietary recommendations should focus on actual food and drink items, rather than just eating occasions.

Reviewer Comments:

Author-identified Limitations

- *The core and non-core food approach to identify eating occasions as meals and snacks may lead to differing estimates from other approaches such as time of day or subject-defined occasions. However, the authors re-ran the analyses using time of day and the results did not differ dramatically*
- *Mis-reporting is always a concern with dietary self-reports. The proportion of respondents with implausibly low energy intakes (relative to estimated basal metabolic rate) was similar to that found in the National Diet and Nutrition Survey*
- *Unit non-response may be another source of bias. However, response rates did not differ by BMI.*

Other

- *The subjects were a stratified sub-sample from a larger survey. It is unclear whether the analyses accounted for a non-simple random sample design. The point estimates and estimated standard deviations may not be accurate, and the sample may not be representative of the population*
- *Although the authors acknowledge that under-reporting was similar to that found in a national survey, that does not mean their own estimates are acceptably accurate. Under-reporting is strongly associated with higher BMI, so comparisons between overweight and non-overweight subjects may be particularly biased. Further, under-reporting may be due to omissions of socially unacceptable foods, such as snacks with low nutritional value. Thus, the contribution of snacks to total energy intake, fat, and sugar may be underestimated (i.e., the children are even further from the recommended intakes). Food records are often considered the gold standard for dietary assessment, but severe bias resulting from their use with children and adolescents is not uncommon*
- *With only 40 subjects classified as overweight or obese, the analysis category may not have been large enough to detect any statistical differences from non-overweight or obese children and adolescents.*

Research Design and Implementation Criteria Checklist: Primary Research

Relevance Questions		
1.	Would implementing the studied intervention or procedure (if found successful) result in improved outcomes for the patients/clients/population group? (Not Applicable for some epidemiological studies)	Yes
2.	Did the authors study an outcome (dependent variable) or topic that the patients/clients/population group would care about?	Yes
3.	Is the focus of the intervention or procedure (independent variable) or topic of study a common issue of concern to nutrition or dietetics practice?	Yes
4.	Is the intervention or procedure feasible? (NA for some epidemiological studies)	Yes

Validity Questions		
1.	**Was the research question clearly stated?**	Yes

1.1.	Was (were) the specific intervention(s) or procedure(s) [independent variable(s)] identified?	Yes
1.2.	Was (were) the outcome(s) [dependent variable(s)] clearly indicated?	Yes
1.3.	Were the target population and setting specified?	Yes
2.	**Was the selection of study subjects/patients free from bias?**	Yes
2.1.	Were inclusion/exclusion criteria specified (e.g., risk, point in disease progression, diagnostic or prognosis criteria), and with sufficient detail and without omitting criteria critical to the study?	Yes
2.2.	Were criteria applied equally to all study groups?	Yes
2.3.	Were health, demographics, and other characteristics of subjects described?	Yes
2.4.	Were the subjects/patients a representative sample of the relevant population?	Yes
3.	**Were study groups comparable?**	Yes
3.1.	Was the method of assigning subjects/patients to groups described and unbiased? (Method of randomization identified if RCT)	Yes
3.2.	Were distribution of disease status, prognostic factors, and other factors (e.g., demographics) similar across study groups at baseline?	Yes
3.3.	Were concurrent controls used? (Concurrent preferred over historical controls.)	N/A
3.4.	If cohort study or cross-sectional study, were groups comparable on important confounding factors and/or were preexisting differences accounted for by using appropriate adjustments in statistical analysis?	Yes
3.5.	If case control or cross-sectional study, were potential confounding factors comparable for cases and controls? (If case series or trial with subjects serving as own control, this criterion is not applicable. Criterion may not be applicable in some cross-sectional studies.)	Yes
3.6.	If diagnostic test, was there an independent blind comparison with an appropriate reference standard (e.g., "gold standard")?	N/A
4.	**Was method of handling withdrawals described?**	Yes
4.1.	Were follow-up methods described and the same for all groups?	N/A
4.2.	Was the number, characteristics of withdrawals (i.e., dropouts, lost to follow up, attrition rate) and/or response rate (cross-sectional studies) described for each group? (Follow up goal for a strong study is 80%.)	Yes
4.3.	Were all enrolled subjects/patients (in the original sample) accounted for?	No
4.4.	Were reasons for withdrawals similar across groups?	N/A
4.5.	If diagnostic test, was decision to perform reference test not dependent on results of test under study?	N/A
5.	**Was blinding used to prevent introduction of bias?**	Yes
5.1.	In intervention study, were subjects, clinicians/practitioners, and investigators blinded to treatment group, as appropriate?	N/A
5.2.	Were data collectors blinded for outcomes assessment? (If outcome is measured using an objective test, such as a lab value, this criterion is assumed to be met.)	Yes
5.3.	In cohort study or cross-sectional study, were measurements of outcomes and risk factors blinded?	Yes
5.4.	In case control study, was case definition explicit and case ascertainment not influenced by exposure status?	N/A
5.5.	In diagnostic study, were test results blinded to patient history and other test results?	N/A
6.	**Were intervention/therapeutic regimens/exposure factor or procedure and any comparison(s) described in detail? Were interveningfactors described?**	Yes
6.1.	In RCT or other intervention trial, were protocols described for all regimens studied?	N/A
6.2.	In observational study, were interventions, study settings, and clinicians/provider described?	Yes
6.3.	Was the intensity and duration of the intervention or exposure factor sufficient to produce a meaningful effect?	N/A
6.4.	Was the amount of exposure and, if relevant, subject/patient compliance measured?	N/A

	6.5.	Were co-interventions (e.g., ancillary treatments, other therapies) described?	N/A
	6.6.	Were extra or unplanned treatments described?	N/A
	6.7.	Was the information for 6.4, 6.5, and 6.6 assessed the same way for all groups?	N/A
	6.8.	In diagnostic study, were details of test administration and replication sufficient?	N/A
7.	**Were outcomes clearly defined and the measurements valid and reliable?**		Yes
	7.1.	Were primary and secondary endpoints described and relevant to the question?	N/A
	7.2.	Were nutrition measures appropriate to question and outcomes of concern?	Yes
	7.3.	Was the period of follow-up long enough for important outcome(s) to occur?	N/A
	7.4.	Were the observations and measurements based on standard, valid, and reliable data collection instruments/tests/procedures?	Yes
	7.5.	Was the measurement of effect at an appropriate level of precision?	Yes
	7.6.	Were other factors accounted for (measured) that could affect outcomes?	Yes
	7.7.	Were the measurements conducted consistently across groups?	Yes
8.	**Was the statistical analysis appropriate for the study design and type of outcome indicators?**		Yes
	8.1.	Were statistical analyses adequately described and the results reported appropriately?	Yes
	8.2.	Were correct statistical tests used and assumptions of test not violated?	Yes
	8.3.	Were statistics reported with levels of significance and/or confidence intervals?	Yes
	8.4.	Was "intent to treat" analysis of outcomes done (and as appropriate, was there an analysis of outcomes for those maximally exposed or a dose-response analysis)?	N/A
	8.5.	Were adequate adjustments made for effects of confounding factors that might have affected the outcomes (e.g., multivariate analyses)?	Yes
	8.6.	Was clinical significance as well as statistical significance reported?	Yes
	8.7.	If negative findings, was a power calculation reported to address type 2 error?	No
9.	**Are conclusions supported by results with biases and limitations taken into consideration?**		Yes
	9.1.	Is there a discussion of findings?	Yes
	9.2.	Are biases and study limitations identified and discussed?	Yes
10.	**Is bias due to study's funding or sponsorship unlikely?**		Yes
	10.1.	Were sources of funding and investigators' affiliations described?	Yes
	10.2.	Was the study free from apparent conflict of interest?	Yes